Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2017.20386

67 (2017) 271–283
March

Thermodynamic, equilibrium and kinetic studies of adsorption of Rhodamine B onto activated bamboo carbon

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Received 4 May 2016; Accepted 25 November 2016

ABSTRACT

Activated bamboo carbon (ABC) was chemically synthesized using phosphoric activation method, and the resulting material was used to remove Rhodamine B from aqueous solutions. The surface characteristics of the ABC were studied, and the conditions for the maximum removal of dye were established. The capacity of Rhodamine B removal from ABC was 100% for a system with 0.02 g of ABC and initial Rhodamine B concentration of 50 mg L^{-1} at 300 K. The best-fit adsorption isotherm was Langmuir model with maximum adsorption capacity of 111.11 mg g^{-1} at 300 K. The L4-type adsorption suggests that at low Rhodamine B concentrations, adsorption occurs in a flat orientation and becomes end-on orientation at higher concentrations. Thermodynamic data reveal that the adsorption process is endothermic with increasing entropy and moderately large negative free energy values indicate the feasibility of the adsorption process. Pseudo-second-order kinetic model fitted well to both adsorption and desorption processes suggesting the rate-limiting step involves chemical interactions. Furthermore, intraparticle diffusion model indicates the simultaneous occurrence of three diffusion steps caused by external mass transfer to the bulk solution, intraparticle diffusion and desorption of the adsorbed dye molecules.

Keywords: Activated bamboo carbon; Adsorption; Rhodamine B; Kinetic models; Isotherms; Nano-porous; Thermodynamic study

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